ABBOTT

ACCLAIM™ encore

INFUSION PUMP

For use with list number 12237-04

Technical Service Manual

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Section 1
INTRODUCTION

The Acclaim™ Encore Infusion Pump is an infusion system designed to meet the growing demand for hospital wide, alternate site, and home healthcare device standardization. The Acclaim Encore Infusion Pump delivers parenteral and enteral fluids and whole blood or red blood cell components using a wide variety of standard administration sets and fluid containers. These features make the Acclaim Encore Infusion Pump convenient and cost-effective.

1.1
SCOPE

This manual is organized into 11 sections:

- ❑ Section 1 Introduction
- ❑ Section 2 Warranty
- ❑ Section 3 System Operating Manual
- ❑ Section 4 Theory of Operation
- ❑ Section 5 Maintenance and Service Tests
- ❑ Section 6 Troubleshooting
- ❑ Section 7 Replaceable Parts and Repairs
- ❑ Section 8 Specifications
- ❑ Section 9 Drawings
- ❑ Section 10 Index
- ❑ Technical Service Bulletins

If a problem in device operation cannot be resolved using the information in this manual, contact Abbott Laboratories *(see Section 6.1, Technical Assistance)*.

Specific instructions for operating the device are contained in the Acclaim Encore System Operating Manual. Provision is made for the inclusion of the system operating manual in *Section 3* of this manual.

Note: Figures are rendered as graphic representations to approximate actual product; therefore, figures may not exactly reflect the product.

1.2 CONVENTIONS

The conventions listed in *Table 1-1, Conventions*, are used throughout this manual.

Table 1-1. Conventions

Convention	Application	Example
Italic	Reference to a section, figure, table, or publication	*(see Section 6.1, Technical Assistance)*
[ALL CAPS]	In-text references to touchswitches are described in all caps and enclosed in brackets	[START]
ALL CAPS	Screen displays (as appropriate)	LOW BATTERY
Bold	Emphasis	**Caution: Use proper ESD grounding techniques when handling components.**

Throughout this manual, warnings, cautions, and notes are used to emphasize important information as follows:

WARNING

A WARNING CONTAINS SPECIAL SAFETY EMPHASIS AND MUST BE OBSERVED AT ALL TIMES. FAILURE TO OBSERVE A WARNING IS POTENTIALLY LIFE THREATENING.

CAUTION: A caution usually appears prior to a procedure or statement. A caution contains information that could prevent irreversible equipment damage or failure.

Note: A note highlights information that helps explain a concept or procedure.

1.3 ACRONYMS AND ABBREVIATIONS

Acronyms and abbreviations used in this manual are as follows:

A Ampere
AC Alternating current
A/D Analog-to-digital
ALU Arithmetic logic unit
CMOS Complementary metal-oxide semiconductor
COMM Communication
CPU Central processing unit
DC Direct current

DMM Digital multimeter
DPM Digital pressure meter
ECG Electrocardiograph
EEG Electroencephalogram
EEPROM Electrically erasable/programmable read-only memory
EMG Electromyogram
EMI Electromagnetic interference
EPROM Erasable/programmable read-only memory
ESD Electrostatic discharge
HKDC Housekeeping DC
hr Hour
IC Integrated circuit
ID Identification
I/O Input/output
IPB Illustrated parts breakdown
IV Intravenous
kg Kilogram
kHz Kilohertz
KVO Keep vein open
lbs Pounds
LCD Liquid crystal display
LED Light emitting diode
mA Milliampere
MCU Micro controller unit
MHz Megahertz
mg Milligram
ml Milliliter
ml/hr Milliliter per hour
MOSFET Metal-oxide-semiconductor field-effect transistor
ms Millisecond
mV Millivolt
N/A Not applicable
NMI Non maskable interrupt
NTC Negative temperature coefficient
PAL Programmable array logic
PLD Programmable logic device
PSI Pounds per square inch
PVT Performance verification test
PWA Printed wiring assembly
RAM Random-access memory

RMS	Root-mean-square
ROM	Read-only memory
SW	Switch
SRAM	Static random access memory
V	Volt
V_{CC}	Collector supply voltage
VCO	Voltage-controlled oscillator
VDC	Volts DC
VTBI	Volume to be infused
WDI	Watchdog input
XMIT	Transmit
µA	Microampere
µg	Microgram
µl	Microliter
µs	Microseconds

1.4
USER QUALIFICATION

The Acclaim Encore Infusion Pump is intended for use at the direction or under the supervision of licensed physicians or certified healthcare professionals who are trained in the use of the pump and the administration of parenteral and enteral fluids and drugs, and whole blood or red blood cell components. Training should emphasize preventing related IV complications, including appropriate precautions to prevent accidental infusion of air. The epidural route can be used to provide anesthesia or analgesia.

1.5
ARTIFACTS

Nonhazardous, low-level electrical potentials are commonly observed when fluids are administered using infusion devices. These potentials are well within accepted safety standards, but may create artifacts on voltage-sensing equipment such as ECG, EMG, and EEG machines. These artifacts vary at a rate that is associated with the infusion rate. If the monitoring machine is not operating correctly or has loose or defective connections to its sensing electrodes, these artifacts may be accentuated so as to simulate actual physiological signals. To determine if the abnormality in the monitoring equipment is caused by the pump instead of some other source in the environment, set the pump so that it is temporarily not delivering fluid. Disappearance of the abnormality indicates that it was probably caused by electronic noise generated by the pump. Proper setup and maintenance of the monitoring equipment should eliminate the artifact. Refer to the appropriate monitoring system documentation for setup and maintenance instructions.

1.6 INSTRUMENT INSTALLATION PROCEDURE

CAUTION: Infusion pump damage may occur unless proper care is exercised during product unpacking and installation. The battery may not be fully charged upon receipt of the infusion pump. Do not place the infusion pump in service if it fails the self test.

CAUTION: Infusion pump performance may be degraded by electromagnetic interference (EMI) from devices such as electrosurgical units, cellular phones, and two-way radios. Operation of the infusion pump under such conditions should be avoided.

The instrument installation procedure consists of unpacking, inspection, and self test.

Note: Do not place the infusion pump in service if the battery is not fully charged. To make certain the battery is fully charged, connect the infusion pump to AC power for eight hours *(see Section 8, Specifications)*.

1.6.1 UNPACKING

Inspect the infusion pump shipping container as detailed in *Section 1.6.2, Inspection.* Use care when unpacking the infusion pump. Retain the packing slip and save all packing material in the event it is necessary to return the Acclaim Encore infusion pump to the factory. Verify that the shipping container contains a copy of the system operating manual.

1.6.2
INSPECTION

Inspect the infusion pump packing container for shipping damage. Should any damage be found, contact the delivering carrier immediately.

CAUTION: Inspect the infusion pump for evidence of damage. Do not use the infusion pump if it appears to be damaged. Should damage be found, contact Abbott Laboratories *(see Section 6.1, Technical Assistance)*.

Inspect the infusion pump periodically for signs of defects such as worn accessories, broken connections, or damaged cable assemblies. Also inspect the infusion pump after repair or during cleaning. Replace any damaged or defective external parts.

1.6.3
SELF TEST

CAUTION: Do not place the infusion pump in service if the self test fails.

To perform the self test, refer to *Figure 1-1, LCD Display*, and proceed as follows:

1. Connect the AC power cord to a grounded AC outlet and confirm the AC power indicator illuminates.
2. Open the tubing door and insert a primed administration set into the pump *(see System Operating Manual, Section 4.0, INSTRUCTIONS FOR USE)*. Close the tubing door.
3. Turn on the pump by pressing [ON/OFF].
4. The LCD screen briefly displays all characters. Verify that the screen display matches *Figure 1-1, LCD Display* exactly.

   Note: If the LCD screen does not match *Figure 1-1, LCD Display* exactly, contact Abbott Laboratories.

5. After the infusion pump completes the self test, disconnect it from AC power and confirm that BATTERY displays on the LCD screen.
6. Press [ON/OFF] to turn off the infusion pump. Remove the administration set.
7. To assure the battery is fully charged, connect the AC power cord to a grounded AC outlet for a minimum of eight hours with the pump in the charge mode (off).

   Note: If an alarm condition occurs during the self test, press [ON/OFF] twice and then repeat the self test. If the alarm condition recurs, note the message and take corrective action *(see Section 6.1, Technical Assistance)*. Repeat the self test. If the alarm condition recurs, remove the Acclaim Encore Infusion Pump from service and contact Abbott Laboratories.

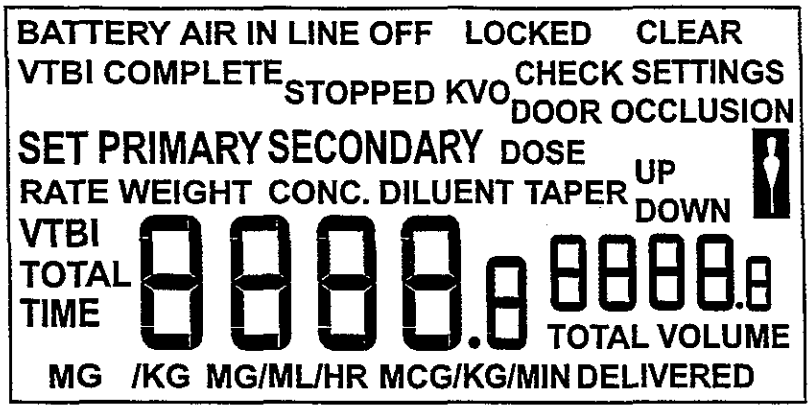

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Figure 1-1. LCD Display

1.7 OPTIONAL USER SETTINGS

There are three settings that may be changed by the user:

1. Distal occlusion alarm pressure level setting
2. Purge feature enable
3. Secondary piggyback alert enable

Table 1-2, Optional User Settings, details these features.

Note: The infusion pump must be off to access the optional user settings.

To enter the optional user settings, press the following key sequence:

1. Press [ON/OFF].
2. During the self test, press and hold PRIMARY [RATE] until the LCD screen blanks.

Table 1-2. Optional User Settings			
Feature	**Default Setting**	**Description**	**Action**
Distal occlusion alarm pressure level setting	L2	Low: L1 nominal	Press PRIMARY [RATE] to toggle between L1, L2, and L3
		Medium: L2 nominal	
		High: L3 nominal	
Purge feature enable	On	The ability to purge during an Air-In-Line alarm	Press PRIMARY [VTBI] to toggle between On and Off
Secondary piggyback alert enable	Off	The pump beeps five times upon completion of secondary delivery and begins primary delivery	Press SECONDARY [RATE] to toggle between On and Off

To switch from Occlusion Level, to Purge Feature, to Secondary Piggyback Alert, press PRIMARY [RATE], PRIMARY [VTBI], and SECONDARY [RATE], respectively.

Cycling the power activates all setting changes.

1.8
GENERAL SERVICE MODE

The general service mode contains all of the features found in the optional user settings and the following features *(see Table 1-3, General Service Mode)*:

- ❑ Software revision number
- ❑ Dose calculation enable (software revision 2.14 or higher)
- ❑ Alarm history review
- ❑ Clear alarm history
- ❑ Run time display
- ❑ Clear battery run time
- ❑ Air-in-line alarm sensitivity

Note: The infusion pump must initially be off to access the general service mode.

To access the general service mode, perform the following key sequence:

1. Press [ON/OFF].
2. During the self test, press and hold [0] until the LCD screen blanks and then displays the software revision number.
3. Select the appropriate action key to review or change the desired feature.
4. To activate all setting changes, press [ON/OFF] to power off the pump. Press [ON/OFF] again to power on the pump, and the new settings will be active.

Table 1-3. General Service Mode

Feature	Default Setting	Description	Action
Software revision number	N/A	Displays the pump software revision	Press [0]
Dose calculation (software revision 2.14 or higher)	OFF	Enables/disables dose calculation feature	Press [DOSE CALC] to display the Set Dose screen **Note:** The Set Dose screen is only accessible from the software revision display screen Press [DOSE CALC] to toggle between On and Off
Alarm history review	N/A	Displays the alarm history list	Press [STOP]
Clear alarm history	N/A	Clears the alarm history list from memory	While viewing the alarm history, press and hold [CLR] for four seconds
Run time display	N/A	Total pump run time is displayed in the large digits and battery run time is displayed in the small digits	Press [CLEAR VOL]
Clear battery run time	N/A	Clears the battery run time to zero (0)	While viewing the run time display, press and hold [CLR] for four seconds
Air-in-line alarm sensitivity level setting	L1	L1: Air-in-line alarms at 100 µl or greater of continuous air, or 200 µl of air in any consecutive 2 ml of fluid L2: Air-in-line alarms at 200 µl or greater of continuous air, or 500 µl of air in any consecutive 2 ml of fluid OFF: Air-in-line alarms at 1500 µl or greater of continuous air	Press SECONDARY [VTBI] Each key press of SECONDARY [VTBI] toggles the sensitivity setting

Section 2

WARRANTY

Subject to the terms and conditions herein, Abbott Laboratories, herein referred to as Abbott, warrants that (a) the product shall conform to Abbott's standard specifications and be free from defects in material and workmanship under normal use and service for a period of one year after purchase, and (b) the replaceable battery shall be free from defects in material and workmanship under normal use and service for a period of 90 days after purchase. Abbott makes no other warranties, express or implied, as to merchantability, fitness for a particular purpose, or any other matter.

Purchaser's exclusive remedy shall be, at Abbott's option, the repair or replacement of the product. In no event shall Abbott's liability arising out of any cause whatsoever (whether such cause be based in contract, negligence, strict liability, other tort, or otherwise) exceed the price of such product, and in no event shall Abbott be liable for incidental, consequential, or special damages or losses or for lost business, revenues, or profits. Warranty product returned to Abbott must be properly packaged and sent freight prepaid.

The foregoing warranty shall be void in the event the product has been misused, damaged, altered, or used other than in accordance with product manuals so as, in Abbott's judgment, to affect its stability or reliability, or in the event the serial or lot number has been altered, effaced, or removed.

The foregoing warranty shall also be void in the event any person, including the Purchaser, performs or attempts to perform any major repair or other service on the product without having been trained by an authorized representative of Abbott and using Abbott documentation and approved spare parts. For purposes of the preceding sentence, "major repair or other service" means any repair or service other than the replacement of accessory items such as batteries, flow detectors, detachable AC power cords, and patient pendants.

In providing any parts for repair or service of the product, Abbott shall have no responsibility or liability for the actions or inactions of the person performing such repair or service, regardless of whether such person has been trained to perform such repair or service. It is understood and acknowledged that any person other than an Abbott representative performing repair or service is not an authorized agent of Abbott.

Section 3

SYSTEM OPERATING MANUAL

A copy of the system operating manual is included with every Acclaim Encore Infusion Pump. Insert a copy here for convenient reference. If a copy of the system operating manual is not available, contact Abbott Laboratories Technical Support Operations *(see Section 6.1, Technical Assistance)*.

Section 4

THEORY OF OPERATION

This section describes the Acclaim Encore Infusion Pump theory of operation. Related drawings are provided in *Section 9, Drawings*. The theory of operation details the infusion pump general description, electronics overview, and mechanical overview of the pump.

4.1 GENERAL DESCRIPTION

The infusion pump includes the following features:

- ❑ Volume to be infused (VTBI) setting
- ❑ Safeguards to protect against over delivery:
  - Anti free-flow
  - Motor speed is continuously monitored
  - Firmware senses malfunctions that could result in gravity flow
- ❑ Volume infused accumulation displays for primary and secondary solutions
- ❑ Flow rate selection from 1.0 to 99.9 ml/hr in 0.1 ml/hr increments and 100 to 999 ml/hr in 1 ml/hr increments
- ❑ Battery operation
- ❑ Self test
- ❑ Automatic memory retention of all previous therapy settings and fluid delivery data until cleared by user
- ❑ Alarms include the following:
  - OCCLUSION
  - AIR-IN-LINE
  - LOW BATTERY
  - CHECK DOOR
  - CHECK SETTINGS
  - VTBI COMPLETE
  - LOCKED
- ❑ Three-level adjustable alarm volume
- ❑ Taper mode
- ❑ Dose calculation
- ❑ Lockout

4.2 ELECTRONICS OVERVIEW

This section describes the function and electronic circuitry of each printed wiring assembly (PWA) in the infusion pump: power supply PWA, micro controller unit (MCU) PWA, volume control and lockout PWA, LCD display PWA, pressure sensor PWA, and bubble sensor PWA. Schematic diagrams supporting the operation of infusion pump PWAs are in *Section 9, Drawings*.

4.2.1 POWER SUPPLY PWA

The power supply PWA provides direct current (DC) power to system circuits and charges the battery *(see Figure 9-8, Power Supply PWA Schematic)*. The power supply PWA consists of switcher circuitry, startup/shutdown circuitry, and battery charger circuitry. The following sections describe these circuits.

4.2.1.1 SWITCHER CIRCUITRY

The main function of the switcher circuitry is to convert alternating current (AC) line power to an isolated +11 volts DC (VDC). Fuses F1 and F2, and variable resistor VR1 provide protection against AC line-high voltage spikes and protection from fire. Capacitors C1, C2, and C6, and transformers T1 and T2 attenuate conducted emissions. Bridge rectifier U1, and capacitor C7 provide the DC voltage required for switcher circuit. Resistor R1 provides the bias for the current mode-switcher controller integrated circuit (IC) U2. U2 oscillates at approximately 40 kilohertz (kHz), determined by external components resistor R15 and capacitor C17. U2 controls the duty cycle of Q3 by feedback at pin 2. Resistor R10 provides current sensing. Resistor R16 and capacitor C14 filter the ramp voltage across R10 and feed it back to U2.

The peak voltage across resistor R10 controls the delivered power through transformer T3 to limit the output current. Voltage at U2-3 is limited to +1.0 VDC so that peak current through transistor Q1 is limited to approximately 2.0 amperes (A). This limit protects the output from short circuits.

Optocoupler U4 is part of the main regulation loop; it provides the UL-544 isolation barrier. U4 is part of a redundant loop that prevents overvoltage if the main loop fails. Diode CR8 and the clamp winding of transformer T3 provide protection from transformer leakage inductance and limit the peak voltage across transistor Q3.

Diode CR13 and capacitors C22 and C23 rectify the transformer T3 voltage to create the main DC voltage source (+BUS) for the infusion system. Diode CR12, resistor R24, IC U3, and capacitor C21 constitute a secondary control loop for protection in case of primary loop failure. Diode CR14 and capacitor C25 create a forward converted negative voltage across capacitor C25 to switch transistor Q8 on through diode CR16 and resistor R36. The Q8 output, housekeeping DC (HKDC), provides the necessary voltage to bias the main regulation loop and the charger circuitry. HKDC is low when AC is off. Resistors R47, R50, and R63; capacitors C35, C34, and C26; and IC U8 filter HKDC and create a stable +2.5 VDC reference voltage (VREF2.5V).

Resistors R44, R51, R45, and R26; capacitor C28; and components U6A and U4 constitute the main control loop. Transistor Q4, resistor R35, and diode CR15 enable voltage regulation only after +BUS reaches +5 VDC.

4.2.1.2
STARTUP/SHUTDOWN CIRCUITRY

The startup/shutdown circuitry controls SWMAIN, VMOT, V5_0, and VANA. The AC power and the battery bias the main +BUS. If AC power is present, HKDC is active, transistors Q6 and Q10 switch on, enabling the SWMAIN bus.

If AC power is not present, momentary application of SPSTIN enables Q12 which is Diode-ORd with the control of Q6. PWRHLD is then asserted by the MCU PWA and SPSTIN may be released.

When SWMAIN is active, VMOT is also active. VMOT is protected from gross overloads (shorts) by fuse F3. SWMAIN provides power for the logic and analog circuits, V5_0, and VANA. V5_0, and VANA are regulated by Q7.

4.2.1.3
BATTERY CHARGER CIRCUITRY

The main function of the battery charger circuitry is to charge the battery. The main component of the battery charger circuitry is a constant current source comprised of transistors Q9 and Q11, IC U6B, resistor R37, and associated passive devices. Q9 is the current-carrying device and R37 is the sense resistor. When AC is off, Q11 is off and the parasitic diode within MOSFET Q9 carries the load current.

The battery is charged by two current levels and trickle current (R38). Charge current control is achieved by controlling the voltage at U6-6 by the signals low charge (LOCHG), charge off (CHRG_OFF), and battery 2 (BAT2). The BAT2 signal is active when a short is introduced at battery connector J19-3 and J19-4 (an active BAT2 signal implies battery type 2 is connected to connector J19). The charge current in this case is lower due to Q10 conducting.

Table 4-1, Battery Charge Current States, lists the charge current state as a function of the control signals.

Table 4-1. Battery Charge Current States

LOCHG Signal	CHRG_OFF Signal	J19-3 to J19-4	Approximate Current
Low	Low	Short	0.66 A
Low	Low	Open	1.00 A
High	Low	Short	0.13 A
High	Low	Open	0.20 A
High or low	High	High or low	Trickle = (11-Vbat)/475

IC U7A also offers overpower protection for transistor Q9. When the voltage across Q9 generates more than +2.5 VDC at U7-2, the charge current switches to low.

IC U5B is a differential amplifier that monitors the battery voltage as the battery is being charged. BATV is a scaled analog signal sent to the MCU PWA where it is used to monitor the charge state of the battery.

4.2.2
MCU PWA

The MCU PWA is comprised of an NEC 78C10 micro controller, U3. The MCU PWA has external RAM, a 16 bit ALU, an eight channel 8 bit A/D converter, multifunction timers/ event counters, and a general purpose interface. The MCU PWA is comprised of the following functional circuits:

- Microprocessor supervisory circuitry (power fail, watchdog, and power on reset)
- Serial communication circuitry
- Alarm logic circuitry
- Alarm power backup circuitry
- Programmable micro controller peripheral circuitry
- Motor driver circuitry

4.2.2.1
MICROPROCESSOR SUPERVISORY CIRCUITRY

The microprocessor supervisory circuit U10 provides power supply monitoring and battery control functions for microprocessor reset, power failure warning, and watchdog timing. It is important to protect the system during power transitions and the micro controller needs to be reset after the collector supply voltage (V_{CC}) power supply is applied. The microprocessor supervisory circuit U10 generates a reset pulse during power-up or power-down.

Power on reset events keep *RESET low, which causes the watchdog timer internal timer to be reset. The *RESET signal is kept low throughout the entire power on reset cycle, which prevents enabling of the watchdog timer. Once the timer starts, software has to reset it by strobing U10 WDI signal input pin within a specified frequency, which generates a reset event if a WDI strobe is not received.

During a hard power-up, the watchdog timer times out, generating a reset prior to strobing WDI to test the timer functionality. This test can be performed by connecting the infusion pump to AC power and confirming the LCD backlight flashes and an audible beep sounds.

When V_{CC} falls below the reset threshold voltage, signal *RESET goes active and holds the micro controller and MCU peripheral in reset, turning off motor drive current, and generating a continuous audible alarm until V_{CC} rises above the threshold voltage.

A second voltage monitor is set to trip a micro controller non maskable interrupt (NMI) event for shutdown when VMOT falls below 6.5 VDC. This early detection provides the micro controller time to write a code word to the EEPROM on the bubble sensor PWA allowing for a secure restart. A catastrophic power failure event can be caused when removing AC power while operating the infusion pump with a dead battery.

4.2.2.2
SERIAL COMMUNICATION CIRCUITRY

The micro controller serial communication port interchanges data between the MCU PWA and either the LCD PWA (CMOS LCD driver), or the Pressure Sensor PWA (EEPROM and Pressure Sensor ADC). Data is transmitted or received to and from the LCD driver, EEPROM, and Pressure Sensor ADC over the same serial port. Chip select lines CS_EE*, CS_ADC*, and LCD_ENB determine which device is in communication. The CMOS LCD driver and Pressure Sensor ADC share the same clock, SCK, which is generated from the micro controller. The EEPROM has an independent clock signal, EE_CLK, supplied from the programmable micro controller peripheral, but generated from SCK. The independent clock signal is necessary due to the EEPROM requiring an inverted clock signal to perform certain operations.

4.2.2.3
ALARM LOGIC CIRCUITRY

An audible alarm is generated by signal MCU_ALARM. When MCU_ALARM goes active, transistor Q9 turns on, pulling current through the piezo alarm transducer, generating an audible alarm. The MCU_ALARM signal is generated by programmable micro controller peripheral U1 which uses internal timers to generate desired alarm frequencies.

Voltage VSENSE is amplified through U4 and fed into a micro controller A/D converter. This amplified signal, BUZTST, monitors the voltage drop across R73 to sense if current is flowing through the piezo alarm transducer. The feedback is monitored, which causes LCD ERR code to be generated when the piezo alarm transducer is not functioning.

4.2.2.4
ALARM POWER BACKUP CIRCUITRY

The alarm power backup circuitry is provided through capacitor C38. C38 provides power backup to drive the audible alarm when catastrophic failures occur, such as removal of AC power while operating the infusion pump with a dead battery. C38 is an oil Farad super capacitor able to hold a voltage for a long period of time. Diodes CR1-CR3 route power for the alarm buzzer driver Q9 from either V_{CC} or C38.

4.2.2.5
PROGRAMMABLE MICRO CONTROLLER PERIPHERAL CIRCUITRY

The programmable micro controller peripheral chip U1 interfaces directly with micro controller U3 and consists of a 512K bit erasable/programmable read only memory (EPROM), 16K bits of static random access memory (SRAM), and multipurpose programmable logic devices (PLD).

4.2.2.6
MOTOR DRIVER CIRCUITRY

The pump motor is driven by a bipolar chopper circuit with the output transistors configured into a dual H-bridge configuration. Transistors in Q1 and Q3 drive motor coil A and the transistors in Q2 and Q4 drive motor coil B. Software controls the motor with four digital lines (MOT_A1, MOT_A2, MOT_B1, MOT_B2) and a D/A voltage (I_SET). Motor coil current polarity in both windings is set by the four digital lines input to the motor control PAL device U6. The motor coil current magnitude is set by the D/A converter output voltage (I_SET) input to the chopper modulation circuit.

Motor current is set depending on the step rate. When the motor is idling (not moving), the current is set at a low level for holding torque at the stopped step position. As the motor is stepped faster, the motor current is set higher.

4.2.2.6.1
H-Bridge Driver Circuit

A bipolar wound motor has two independent windings with current driven in both directions for each winding. When only a positive VMOT supply voltage is available, an H-bridge driver circuit is used to drive current in both directions through a single winding.

The output drive transistors are arranged in an H pattern with a motor winding forming the horizontal member of the H. Four transistors form the vertical members of the H *(see Figure 4-1, H-Bridge Driver Circuit)*. This pattern is repeated for both sides of the motor, windings A and B. These transistors are N-channel MOSFETs on the bottom legs and P-channel MOSFETs on the top legs.

Whereas the N-channel gates are controlled relative to ground, the P-channel gates are controlled relative to VMOT where a gate voltage of VMOT turns off the transistor. A level shifter is used to change 5 volt logic signals to a gate drive which swings from ground to VMOT.

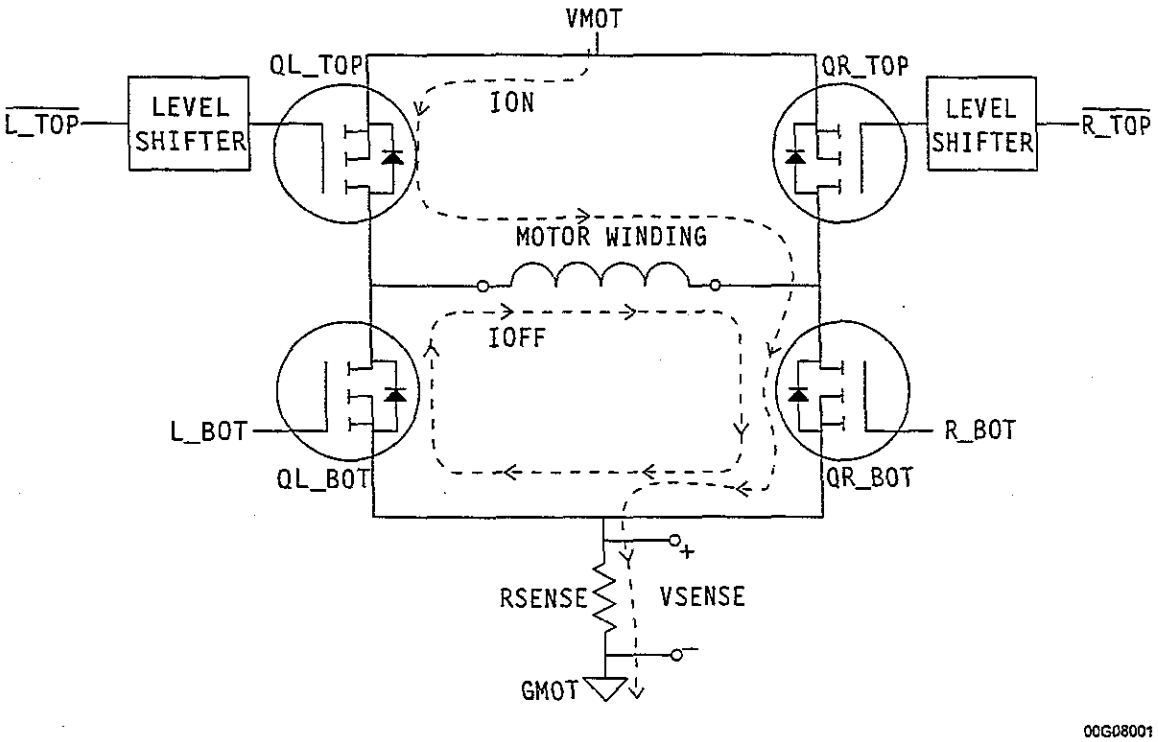


Figure 4-1. H-Bridge Driver Circuit

4.2.2.6.2

Motor Modulation Currents

Motor winding current is chopper controlled by switching the driver transistors on and off in a particular combination. Two currents, I_{ON} and I_{OFF}, are shown in *Figure 4-1, H-Bridge Driver Circuit*, as the modulation current flows from left to right. Current builds up during the I_{ON} phase with Q_{L_TOP} and Q_{R_BOT} transistors turned on. Current stored in the motor winding inductance decays during the i_{OFF} phase with both bottom transistors Q_{L_BOT} and Q_{R_BOT} turned on.

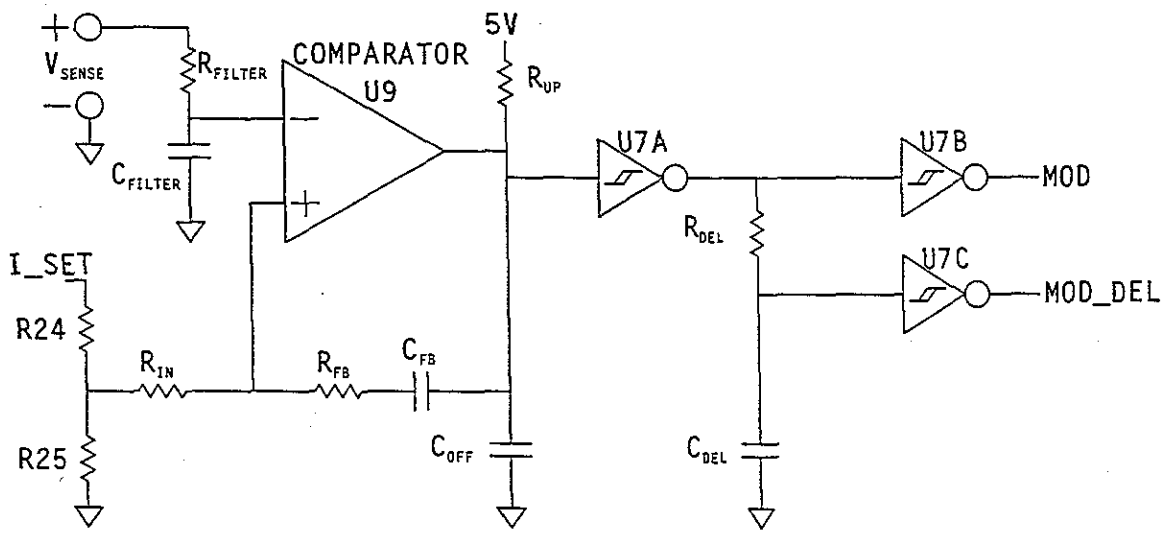
4.2.2.6.3

Modulator

Chopper current is modulated by the circuit shown in *Figure 4-2, Modulator Circuit*. This is a constant off time modulator which turns off the upper driver transistor for a fixed time when the winding current exceeds the threshold set by I_SET. Two modulators are used, one for each motor winding.

Circuit operation starts with the winding current I_{ON} less than the threshold defined by I_SET. Current I_{ON} flows through resistor R_{SENSE} in *Figure 4-1, H-Bridge Driver Circuit*, generating voltage V_{SENSE}. This V_{SENSE} is filtered by R_{FILTER} and C_{FILTER}, then compared to a voltage which is divided down from I_SET by R24 and R25. When V_{SENSE} becomes greater than the divided down I_SET, the output from comparator U9 goes low, discharging capacitor C_{OFF}, which also causes the signal MOD to change from high to low and turns off the driver transistors.

Resistors R_{IN} and R_{FB}, along with capacitor C_{FB}, provide a small amount of positive feedback for threshold hysteresis at the input of U9. Comparator U9 has an open collector output which stays low until V_{SENSE} drops below the divided down I_SET. At that point, capacitor C_{OFF} begins charging with current from RUP. The modulation off time is determined by how long it takes for C_{OFF} to charge to U7 input voltage threshold.



00G08002

Figure 4-2. Modulator Circuit

4.2.2.6.4

Shoot Through Current Protection

All bipolar motor drivers have the potential of turning on both transistors along one side of the H-bridge driver, which would cause a large shoot through current to flow from VMOT to ground. Turning off both the top and bottom transistors before changing which transistor is turned on prevents shoot through current. The MOD signal is delayed by resistor R_{DEL} and capacitor C_{DEL}, then output as MOD_DEL. When MOD and MOD_DEL are different, both top and bottom transistors are turned off as shown in *Figure 4-3, Chopper Motor Drive Waveforms.*

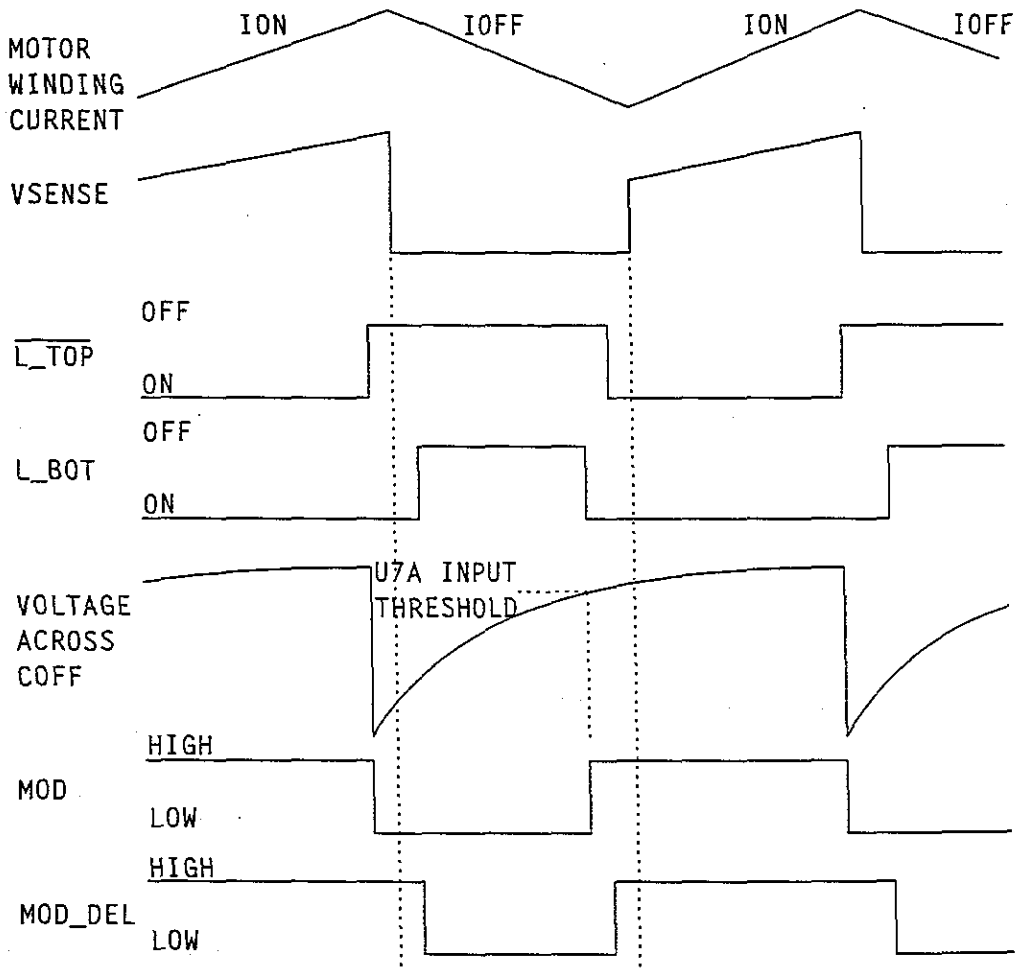


Figure 4-3. Chopper Motor Drive Waveforms

4.2.3
VOLUME CONTROL AND LOCKOUT PWA

Alarm volume control and keypad lockout are provided by the volume control and lockout PWA mounted on the inside of the rear enclosure. This location provides external access to the panel mounted switches on the PWA.

4.2.3.1
HIGH VOLUME AUDIBLE ALARM

The audible alarm audio level is externally adjustable by a three-way toggle switch (high, medium, and low) on the rear of the infusion pump.

4.2.3.2
FRONT PANEL LOCKOUT SWITCH

A push-button switch located externally on the rear of the infusion pump allows the front panel keypad switches to be enabled or disabled. The [STOP] keypad switch cannot be disabled.

4.2.4
LCD DISPLAY PWA

The LCD display PWA consists of an LCD driver integrated chip (IC), U2, an LCD module, U4, an LED backlight panel, U5 with drive circuitry, and two LED indicators. The keypad connects directly to display PWA jack J14.

4.2.4.1
LCD DRIVER

The LCD driver is a CMOS device that drives the LCD in a master configuration capable of driving 128 segments; 32 frontplane and 4 backplane control waveforms.

Data input (LCD_DATA) and storage is controlled at U2 pins D_{IN}, DCLK, A0, A1, A2, and ENB. Data clock (LCD_CLK) is provided directly from the micro controller. The LCD drive and timing is derived from an internal oscillator.

Data is shifted serially into the 128 bit shift register and arranged into four consecutive blocks of 32 parallel data bits. A time-multiplex of the four backplane drivers is made (each backplane driver becomes sequentially active, and then inactive). At the start of each backplane active period, the corresponding block of 32 bits is made available to the frontplane drivers.

The clock from the LCD driver chip (an independent time base with a frequency of 40 kHz - 80 kHz) clocks a 6 bit counter in the programmable micro controller peripheral device U1. This clock is used to compare the micro controller U3 internal timing (based on the 12 MHz crystal) against an independent time base to assure the relative accuracy of the two time bases.

4.2.4.2
LED BACKLIGHT PANEL AND DRIVER

LED backlight panel U5 is used to backlight the LCD display. The micro controller U3 port line, BACKLITE_ON, controls the LED panel (on or off). When the BACKLITE_ON signal is active, the LED backlight panel is turned on.

The backlight panel is an array of up to 60 LEDs arranged as parallel elements of two LEDs in series. The panel's required drive voltage must equal two forward drops of the LEDs, which is approximately 4.2 VDC. The actual forward voltage changes with temperature and LED variations and is compensated for by using a constant current drive. This current is regulated using a current mode switching technique for high efficiency operation over a wide power supply VMOT range of approximately 7 VDC to 11 VDC.

4.2.4.3
LED INDICATOR CIRCUITRY

Two green LED indicators, DS1 and DS2, provide RUN and LINE POWER status. The RUN indicator LED is controlled by RUNLED_ON signal directly from a micro controller I/O port. The LINE POWER indicator LED is controlled by power supply VHK signal, which is asserted whenever the infusion pump is connected to AC power.

4.2.4.4
KEYPAD CIRCUITRY

The keypad is used for operator control and data entry. The 5x5 switch matrix keypad is connected to the display PWA through a 12 pin connector (J14). The keypad has a soft power [ON/OFF] switch. ESD protection is provided by U6 which high speed clamps with 14 input lines for protection against high voltage transients generated from ESD.

4.2.5
PRESSURE SENSOR PWA

The pressure sensor PWA is comprised of the following sections: EEPROM, A/D converter, bridge drive, distal pressure amp, proximal pressure amp, and temperature sensor *(see Figure 9-5, Pressure Sensor PWA Schematic)*.

4.2.5.1
EEPROM CIRCUITRY

The EEPROM circuitry (IC U6) communicates serially with the MCU PWA. U6 receives commands and data through pin 3 as TXD. Stored data is transferred through pin 4 as RXD. Data is synchronously clocked with EE_CLK at pin 2 when CS_EE is active at pin 1. The function of TXD and RXD is shared with the A/D converter and the display controller.

4.2.5.2
A/D CONVERTER CIRCUITRY

The A/D converter circuitry (IC U1) is a self contained 10 bit, 8 channel A/D converter that communicates serially to the MCU PWA. Control is effected through pin 17 as TXD, and output data is communicated through pin 15 as RXD. The A/D converter has two clock modes, internal and external. The external mode is utilized in the pressure sensor PWA. Data is synchronously clocked with LCD_CLK at pin 19 when CS_ADC* is active at pin 18. The circuit provides a precision 4.096 volt reference (V4_1) for the pressure transducer bridge drive at pin 11. Self diagnostic checks are made by the MCU by reading the last three channels (5, 6, and 7). The inputs to the A/D are filtered to remove spurious noise.

4.2.5.3
BRIDGE DRIVE CIRCUITRY

The bridge drive circuitry (IC U4 and transistor Q4) provides a precision 2.5 volt bias to the excitation inputs of the distal and proximal pressure transducers (EXIH). To conserve power, the excitation is gated under control of the MCU by Q1. Each of the pressure transducers presents a 300 ohm (Ω) load to EXIH.

4.2.5.4
DISTAL PRESSURE AMPLIFIER CIRCUITRY

The distal pressure amplifier circuitry (IC U5B and U3A) is a differential amplifier with a gain of approximately 1865 V/V (U5 has a gain of 205, U3 is 9.1). Offset trim is effected by potentiometer R41 and is adjusted during manufacture to balance the output to a value that allows negative excursions of pressure to be measured. Offset trim typically is set to yield a pressure output of 0.5 volts with no pressure present.

4.2.5.5
PROXIMAL PRESSURE AMPLIFIER CIRCUITRY

The proximal pressure amplifier circuitry is identical to the distal pressure amplifier circuitry.

4.2.5.6
TEMPERATURE SENSOR CIRCUITRY

The temperature sensor circuitry is composed of resistors R2, R3, R51, and R52 which provide bias to four 100K NTC thermistors in the sensor test head. At 25 degrees Celsius, each test point (TEMP_AMB1, TEMP_AMB2, TEMP_TUBE1, and TEMP_TUBE2) measures approximately 2.048 volts.

4.2.6
BUBBLE SENSOR PWA

The bubble sensor PWA consists of the following circuitry: transmitter, receiver, and position sensor circuitry *(see Figure 9-6, Bubble Sensor PWA Schematic)*. The bubble sensor monitors tubing distal to the pumping head.

4.2.6.1
TRANSMITTER CIRCUITRY

The transmitter circuitry consists of a sweep oscillator, a voltage-controlled oscillator (VCO), and a driver.

The sweep oscillator (ICs U2A and portion of U9, capacitor C28, and resistor R63) oscillates at approximately 12 kHz with a 50 percent duty cycle. A complementary metal-oxide semiconductor (CMOS) gate within U9 is used for a quality rail-to-rail symmetrical signal for greater timing accuracy. The output of the sweep oscillator (C28) is between +2 VDC and +3 VDC. The C28 output is used to sweep the VCO at U9-9.

IC U9, capacitor C27, and resistors R70 and R71 constitute the VCO. U9 is originally a phase-lock loop (PLL) IC with the VCO portion sweeping output frequencies from 4 megahertz (MHz) to 6 MHz. The VCO center frequency is determined by R70 and C27. Activating air enable (AIRT_EN), enables the VCO.

The driver consists of a push-pull, emitter-follower complementary pair of transistors: Q4 and Q9. The driver supplies input to the air sensor through capacitor C26.

4.2.6.2
RECEIVER CIRCUITRY

The receiver circuitry consists of an amplifier, detector, and buffer.

The amplifier consists of transistors Q7, Q8, and associated passive components. The amplifier is biased by VANA. Q6 is biased by AIRR_EN in order to enable the receiver.

The detector is an emitter-follower transistor Q5. Capacitor C14 and resistor R22 constitute a time constant of 300 microseconds (µs). Since the time between peaks is approximately 40 milliseconds (ms), the output (AIR) remains high with a pronounced sawtooth ripple.

The buffer (IC U2B and resistors R17 and R23) also amplifies the detected signal.

4.2.6.3
POSITION SENSOR CIRCUITRY

The bubble sensor PWA has three sensor inputs to detect the door, anti-free-flow, and crankshaft position.

The door is magnetically sensed by a Hall-effect sensor (IC U1)and is enabled by the MCU DOOR_AFF_EN through inverter U8 pin 10 and transistor Q3. This drive also enables the slotted opto-sensor for the anti-free-flow position detector. The DOOR signal is high when enabled and the door is closed.

The anti-free-flow position detector monitors the slide position flag and is buffered by inverter U8 pin 4. The AFFK_FLAG output is high when enabled and the flag is open.

The crankshaft position is monitored by a slotted opto-sensor (SW1) and is enabled by the MCU's MOTFLAG_EN through transistor Q2. At the end of the infusion pump stroke, a hole in the timing wheel is sensed. When enabled, and at the timing mark, inverter U8 pin 2 drives PUMP_FLAG low.

4.3 MECHANICAL OVERVIEW

The Acclaim Encore Infusion Pump uses a section of the administration set tubing as a pumping chamber. A row of eight keys, each with an associated eccentric cam mounted on a crankshaft, operate together against the tubing to create a sinusoidally advancing wave that forces fluid to flow through the tubing. Approximately 100 µl of fluid is delivered with every stroke (full wave) of the keys.

4.3.1 MECHANISM ASSEMBLY

The mechanism assembly is a fully self-contained unit consisting of the following:

- Stepper motor with a timing belt connected to a crankshaft/eccentric cam assembly
- Platen/spring assembly
- Proximal and distal pressure sensors
- Ultrasonic air sensor
- Temperature sensor
- Flood clamp actuator
- Anti free-flow actuator

During infusion pump operation, the mechanism assembly stepper motor drives a timing belt that is coupled to a crankshaft. The motor action rotates the crankshaft causing the eccentric cams to press on the appropriate keys in the pumping head. One rotation of the crankshaft completes one stroke, or a full wave motion of the keys.

The sinusoidal wave actuation of the pumping head forces the tubing against the platen/spring assembly located on the door. Each key is slightly lower than the previous key. As the wave action progresses, an increase in fluid pressure is created within the tubing, forces the fluid out the distal end of the tubing, and pulls fluid into the tubing from the proximal end.

4.3.1.1 MOTOR AND CRANKSHAFT/ECCENTRIC CAM ASSEMBLIES

The motor and crankshaft/eccentric cam assemblies operate together to actuate the eight keys in the pumping head.

The stepper motor is a permanent magnet stepper motor. The motor rotation is coupled to the crankshaft via two gears and a timing belt. The motor to crankshaft gear ratio is 1.5:1.

Cam position is sensed by an optical encoder that provides one pulse per cam revolution.

For fluid delivery rates less than 125 ml/hr, the motor stops four or more times per pump cycle. The maximum motor stop period is approximately 14 seconds when a fluid delivery rate of 1 ml/hr is selected.

4.3.1.2
PUMPING HEAD

The pumping head is comprised of eight keys that apply the actual pressure to the tubing. As the crankshaft rotates, the eccentric cams press on the tubing, cycling from one cam to the next in the series, forcing the fluid down the tubing towards the distal end.

4.3.1.3
PROXIMAL PRESSURE SENSOR

The proximal pressure sensor monitors fluid pressure within the proximal section of the tubing. The proximal pressure sensor uses a strain gauge mounted to a leaf spring that is coupled to the tubing. Pressure fluctuations inside the tubing cause deflections in the tubing wall. These deflections are coupled to the sensor. Deflections in the sensor induce resistance changes in the strain gauge.

4.3.1.4
DISTAL PRESSURE SENSOR

The distal pressure sensor operates in the same manner as the proximal pressure sensor, with the exception that it is coupled to the distal section of the tubing.

4.3.1.5
ULTRASONIC AIR SENSOR

The ultrasonic air sensor is mounted so the tubing distal to the pumping head passes between the transmit and receive transducers.

While small bubbles may lodge in the pumping head, large air bubbles advance through the tubing. The ultrasonic air sensor can be set to one of three settings *(see Section 1.8, General Service Mode)*. The three settings alarm at the following levels:

- L1: Air-In-Line alarms at 100 µl or greater of continuous air or 200 µl of air in any consecutive 2 ml of fluid
- L2: Air-In-Line alarms at 200 µl or greater of continuous air or 500 µl of air in any consecutive 2 ml of fluid
- OFF: Air-In-Line alarms at 1500 µl or greater of continuous air

4.3.1.6
TEMPERATURE SENSOR

The Acclaim Encore Infusion Pump has two temperature sensors to compensate for the effect that temperature has on fluid volume delivered. One temperature sensor measures the ambient temperature ($T_{AMBIENT}$), and one measures the tubing temperature (T_{TUBE}). Software computes the temperature of the fluid (T_{ACTUAL}) from these two values and then compensates the stroke volume delivered.

If either of the two temperature sensors measure four consecutive readings >50° C or <0° C, a temperature sensor malfunction error code is displayed *(see Table 6-2, Error Codes Requiring Technical Service)*.

4.3.1.7
FLOOD CLAMP ACTUATOR

The flood clamp actuator is located at the distal end of the pumping head. It automatically clamps the administration set tubing when the door is opened. The flood clamp actuator can be manually opened to unclamp the tubing by depressing the finger plate.

4.3.1.8
ANTI FREE-FLOW ACTUATOR

For pumping operation, a slide clamp is inserted into a slot at the proximal end of the pumping head *(see System Operating Manual)*. This slide clamp is positioned by the anti-free-flow actuator. When the door is opened, the anti-free-flow actuator pushes the slide clamp to the closed position, preventing free-flow. When the door is closed, the anti-free-flow actuator pushes the slide clamp into the open position.

Section 5

MAINTENANCE AND SERVICE TESTS

A complete maintenance program promotes infusion pump longevity and trouble-free instrument operation. Such a program should include routine maintenance, periodic maintenance inspection, and following any repair procedure, performance verification testing.

5.1 ROUTINE MAINTENANCE

Routine maintenance consists of basic inspection and cleaning procedures. As a minimum requirement, inspect and clean the infusion pump after each use. In addition, establish a regular cleaning schedule for the infusion pump.

5.1.1 INSPECTING THE INFUSION PUMP

Inspect the infusion pump periodically for signs of defects such as worn accessories, broken instrument connections, or damaged cables. In addition, inspect the infusion pump after repair or during cleaning. Replace any damaged or defective external parts. See *Section 5.2.2, Inspecting the Infusion Pump*, for a detailed list of areas to be inspected.

5.1.2 CLEANING THE INFUSION PUMP

The following procedures are designed to maintain the infusion pump, sustain system longevity, and promote trouble-free instrument operation.

Follow hospital protocol for establishing the infusion pump cleaning schedule.

WARNING

DISCONNECT THE INFUSION PUMP FROM AC POWER PRIOR TO CLEANING THE INSTRUMENT. FAILURE TO COMPLY WITH THIS WARNING COULD RESULT IN ELECTRICAL SHOCK.

CAUTION: Do not immerse the infusion pump in liquids. Immersion could damage the instrument. Do not allow liquids to enter the infusion pump electronics compartment.

CAUTION: Do not spray cleaning solutions toward any openings in the infusion pump.

CAUTION: Certain cleaning and sanitizing compounds may slowly degrade components made from some plastic materials. Using abrasive cleaners or cleaning solutions not recommended by Abbott Laboratories may result in product damage and, potentially, void the product warranty. Do not use compounds containing combinations of isopropyl alcohol and dimethyl benzyl ammonium chloride.

Clean the exposed surfaces of the infusion pump with a soft, lint-free cloth dampened with one of the cleaning solutions listed in *Table 5-1, Cleaning Solutions*, or a mild solution of soapy water. Remove soap residue with clear water. Do not use solvents that are harmful to plastic, such as isopropyl alcohol or acetone. Do not use abrasive cleaners.

CAUTION: To avoid infusion pump damage, cleaning solutions should be used only as directed in *Table 5-1*. The disinfecting properties of cleaning solutions vary; consult the manufacturer for specific information.

Table 5-1. Cleaning Solutions

Cleaning Solution	Manufacturer	Preparation
Coverage™ HBV	Steris Corporation, a division of Calgon Vestal Laboratories	Per manufacturer's recommendation
Formula C™	Diversey Corporation	Per manufacturer's recommendation
Manu-Klenz®	Calgon Vestal Laboratories	Per manufacturer's recommendation
Sporicidin®	Sporicidin International	Per manufacturer's recommendation
Super Edisonite®	S. M. Edison Chemical Co.	Per manufacturer's recommendation
Vesphene® IIse	Calgon Vestal Laboratories	Per manufacturer's recommendation
Household bleach	Various	Per hospital procedures; do not exceed one part bleach in ten parts water

5.1.3
SANITIZING THE INFUSION PUMP

Sanitize the external surfaces of the infusion pump using a cleaning solution listed in *Table 5-1, Cleaning Solutions*.

Note: Not all cleaning solutions are sanitizers. Check product labeling.

CAUTION: Do not sterilize the infusion pump using heat, steam, ethylene oxide (ETO), or radiation. These methods may cause the instrument to malfunction.

5.2 PERFORMANCE VERIFICATION TEST

The performance verification test (PVT) consists of the tests described in the following sections. The PVT can be used for diagnostic purposes during the troubleshooting of a malfunctioning infusion pump. The PVT should be used for performance verification before an infusion pump is placed back in service after repair. If any malfunction is detected as a result of the PVT, refer to *Table 6-3, Troubleshooting with the PVT.*

Note: The PVT must be performed exactly as described in this manual to assure effective and reliable product evaluation information.

5.2.1 EQUIPMENT REQUIRED

The PVT requires the following equipment (or equivalents):

- ❑ Graduated cylinder, 25 ml, with 0.2 ml graduations (Type A)
- ❑ Sterile water or tap water in an IV bag/container
- ❑ Digital pressure meter (DPM), Bio-Tek® DPM II
- ❑ Safety analyzer, DNI Nevada® 231D
- ❑ Three-way stopcock, List No. 3233-01 or 3232-01
- ❑ Standard administration set, List No. 1881 w/slide clamp
- ❑ 21-gauge needle, List No. 4492, or 18-gauge blunt cannula
- ❑ Battery charger test box (P/N 595-88728-002) (optional)
- ❑ Digital multimeter (DMM), Fluke® 8012A (optional)

5.2.2 INSPECTING THE INFUSION PUMP

Inspect the infusion pump periodically for signs of defects such as worn accessories or damaged cables. Also, inspect the infusion pump after repair or during cleaning. Replace any damaged or defective external parts.

Inspect the following areas for missing or damaged parts:

- ❑ Labels
- ❑ AC power cord
- ❑ Velcro® retainer strap
- ❑ Rubber foot pads
- ❑ Door assembly, shield, and handle
- ❑ Keypad switches
- ❑ External screws
- ❑ Pole clamp knob/shaft, extrusion, and tip insert
- ❑ Front and rear enclosures
- ❑ Battery access cover
- ❑ LCD screen

5.2.3
INFUSION PUMP TEST SETUP

WARNING

A PATIENT SHOULD NEVER BE CONNECTED TO THE INFUSION PUMP DURING DEVICE TESTING.

To set up the infusion pump for the PVT, proceed as follows:

1. Note the following hospital specific settings to restore the infusion pump configuration at the end of the PVT:
   - Occlusion level setting
   - Air-In-Line level setting
   - Purge setting
   - Piggyback setting

   See *Section 1.7, Optional User Settings* and *Section 1.8, General Service Mode* for detailed instructions on viewing these settings.
2. Confirm the infusion pump and appropriate accessories are assembled.
3. Hang the sterile water container at a height of 18 ± 6 inches (46 ± 15.3 cm) above the pumping head of the infusion pump.
4. Connect the infusion pump to AC power. Conduct all tests with the infusion pump connected to AC power unless otherwise specified.
5. Turn on the pump by pressing [ON/OFF].
6. Verify the infusion pump is in the unlocked mode. Pressing the [LOCKOUT] switch alternates between unlocked and locked modes.
7. Turn off the pump by pressing [ON/OFF].

5.2.4
SELF TEST

CAUTION: Do not place the infusion pump in service if the self test fails.

To perform the self test, refer to *Figure 5-1, LCD Display*, and proceed as follows:

1. Connect the AC power cord to a grounded AC outlet and confirm the AC power indicator illuminates.
2. Open the tubing door and insert a primed administration set into the pump *(see System Operating Manual, Section 4.0, INSTRUCTIONS FOR USE)*. Close the tubing door.
3. Turn on the pump by pressing [ON/OFF].
4. The LCD screen briefly displays all characters. Verify that the screen display matches *Figure 5-1, LCD Display* exactly.

   Note: If the LCD screen does not match *Figure 5-1, LCD Display* exactly, contact Abbott Laboratories.

5. After the infusion pump completes the internal self test, disconnect it from AC power and confirm that BATTERY displays on the LCD screen and the line power indicator extinguishes.

6. Reconnect the infusion pump to AC power.
7. Press [ON/OFF] to turn off the infusion pump. Remove the administration set.
8. To assure the battery is fully charged, connect the AC power cord to a grounded AC outlet for a minimum of eight hours with the pump in the charge mode (off).

Note: If an alarm condition occurs during the self test, press [ON/OFF] twice and then repeat the self test. If the alarm condition recurs, note the message and take corrective action *(see Section 6, Troubleshooting)*. Repeat the self test. If the alarm condition recurs, remove the Acclaim Encore Infusion Pump from service and contact Abbott Laboratories.

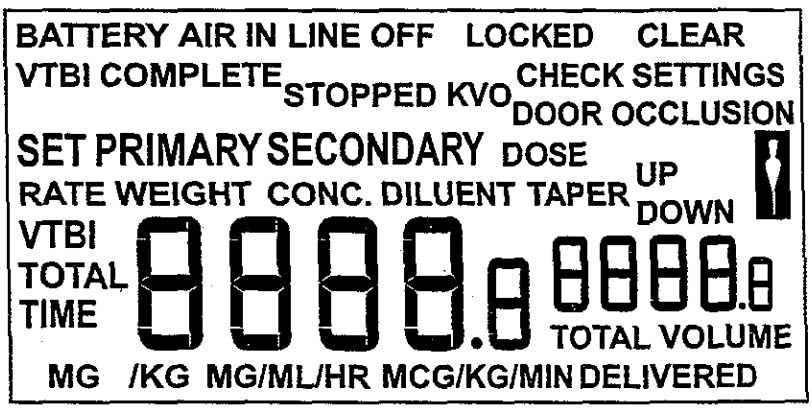


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Figure 5-1. LCD Display

5.2.5
FREE FLOW TEST

To perform the free flow test, proceed as follows:

1. Install and prime a standard administration set. Attach a 21-gauge needle or an 18-gauge blunt cannula to the distal end.
2. Fully open the roller clamp.
3. Place the distal end of the administration set (with needle or cannula attached) 36 inches or more below the fluid level of the IV bag *(see Figure 5-2, Free Flow Test Setup)*.
4. Open the door and immediately shake residual fluid from the end of tubing. Wait 10 seconds and check the distal end of tubing for fluid flow. Verify drops DO NOT form at the tip of the needle faster than one drop every 30 seconds.
5. Close the door. Verify drops DO NOT form at the tip of the needle faster than one drop every 30 seconds.

   Note: A small amount of fluid may be expelled from the tubing when opening or closing the door. Disregard these drops.

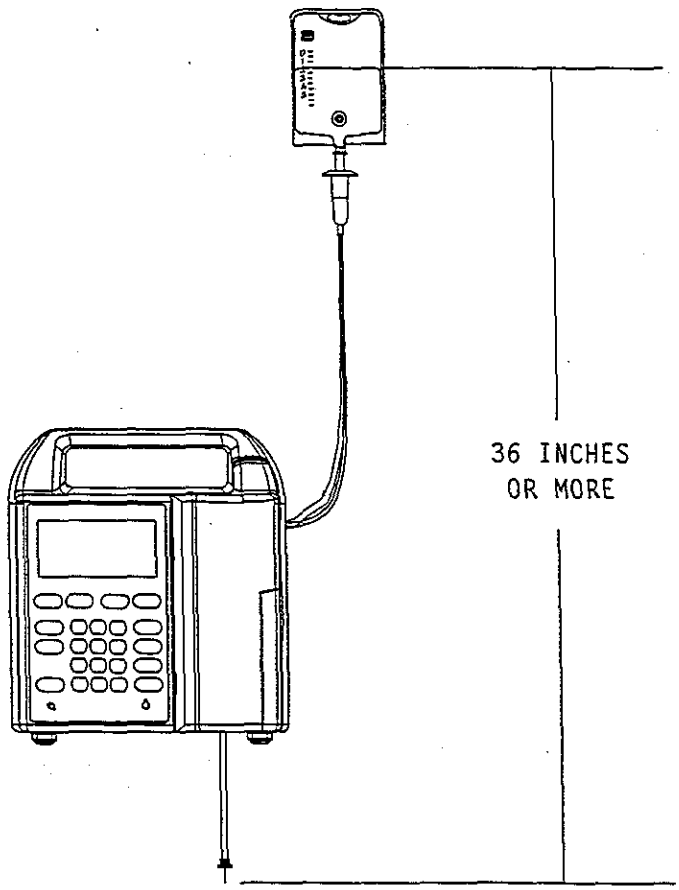

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Figure 5-2. Free Flow Test Setup

5.2.6
KEYPAD TEST

To perform the keypad test, proceed as follows:

1. Press [ON/OFF] to turn on the infusion pump. Verify the pump completes the self test.
2. Verify the LED/LCD/BACKLIGHT is illuminated.
3. Press the following keys to verify that each key activates and the screen responds:
   - [TPN] transfers screen from NORMAL (primary/secondary) to TPN mode

   PRIMARY
   - [RATE] selects the primary fluid for programming the delivery rate
   - [VTBI] selects the primary fluid for programming the volume to be infused/ delivered

   SECONDARY
   - [RATE] selects the secondary fluid for programming the delivery rate
   - [VTBI] selects the secondary fluid for programming the volume to be infused/ delivered
   - [1], [2], [3] changes the rate on the screen
   - [CLR] clears the entered numbers
   - [4], [5], [6] changes the rate on the screen
   - [CLR] clears the entered numbers
   - [7], [8], [9] changes the rate on the screen
   - [CLR] clears the entered numbers
   - [9], [0], [.] [9] changes the rate on the screen
   - [CLR] clears the entered numbers
   - [CLR VOL], [CLR VOL] clears the total volume
4. Press and hold a numeric key for greater than 60 seconds. Verify an audible alarm sounds and the screen displays Er 106.
5. Turn off the pump by pressing [ON/OFF].

5.2.7
DOOR OPEN/ALARM LOUDNESS TEST

To perform the open door/alarm loudness test, proceed as follows:

1. With a primed administration set installed, turn the infusion pump on by pressing [ON/OFF].
2. Set the PRIMARY RATE to 400 ml/hr.
3. Set the PRIMARY VTBI to 10 ml.
4. Press [START].
5. Open the door. Verify the CHECK DOOR legend appears on the LCD screen and an audible alarm sounds.
6. Toggle the [AUDIO SWITCH] to all three positions and verify the audible alarm changes volume.

7. Press [SILENCE]. Verify the alarm mutes.
8. Remove administration set.
9. Reinstall administration set without inserting the slide clamp into the clamp slot.
10. Close the door.
11. Press [START]. Verify the slide clamp icon is on, the backlight flashes, the alarm sounds, and pumping does not start.
12. Open the door.
13. Reinstall administration set with the slide clamp inserted in the clamp slot.
14. Close the door. Verify the slide clamp icon disappears, the backlight stops flashing, and the alarm stops.
15. Turn the infusion pump off by pressing [ON/OFF].

5.2.8
LOCKOUT SWITCH TEST

To perform the lockout switch test, proceed as follows:

1. With a primed administration set installed, turn the infusion pump on by pressing [ON/OFF].
2. Set the PRIMARY RATE to 400 ml/hr.
3. Set the PRIMARY VTBI to 100 ml.
4. Press [START].
5. Press the lockout switch (located on the rear panel). Verify LOCKED appears on the LCD screen.
6. Press PRIMARY [RATE] then press any number button. Verify the infusion pump does not respond and continues operating with no alarms.
7. Press [STOP]. Verify the pump stops pumping, an alarm sounds, and the display backlight and LOCKED flash.
8. Press the lockout switch. Verify LOCKED disappears from the LCD screen.
9. Turn the infusion pump off by pressing [ON/OFF].

5.2.9
PROXIMAL OCCLUSION TEST

To perform the proximal occlusion test, proceed as follows:

1. With a primed administration set installed, press [ON/OFF] to turn the infusion pump on.
2. Press PRIMARY [RATE] and set the rate to 400 ml/hr.
3. Press PRIMARY [VTBI] and set the VTBI to 100 ml.
4. Press [START] to start pumping fluid.
5. After three pumping cycles, clamp the tubing proximal to the infusion pump. After drops stop falling through the sight chamber, verify that an occlusion alarm occurs within three pumping cycles.
6. Unclamp the proximal tubing.
7. Press [STOP].
8. Press [ON/OFF] to turn the infusion pump off.

5.2.10
AIR-IN-LINE ALARM TEST

To perform the air-in-line alarm test, proceed as follows:

Note: Ensure the Air-In-Line sensitivity is set to L1 or L2 for this test.

1. With a primed administration set installed, press [ON/OFF] to turn the infusion pump on.
2. Press PRIMARY [RATE] and set the rate to 400 ml/hr.
3. Press PRIMARY [VTBI] and set the VTBI to 100 ml.
4. Press [START] to start pumping fluid.
5. Introduce a two-to-three inch air bubble into the fluid tubing by inverting the drip chamber.
6. Verify AIR IN LINE displays on the LCD screen and an audible alarm sounds.
7. Press [STOP].
8. Press [ON/OFF] to turn the infusion pump off and remove administration set.

5.2.11
DISTAL OCCLUSION TEST

To perform the distal occlusion test, refer to *Figure 5-3, Occlusion Test Setup*, and proceed as follows:

1. With a primed administration set installed, connect the distal tubing to the DPM through a three-way stopcock as illustrated in *Figure 5-3.*

   Note: A reflux valve may be attached between the stopcock and the DPM to keep moisture out of the DPM.

   Note: The height of the DPM must be 0 ± 12 inches from the midline of the pumping chamber.

   Note: The tubing length distal to the infusion pump must be 39 inches or greater.

2. Enter the Optional User Settings *(Section 1.7, Optional User Settings).*
3. Press PRIMARY [RATE] to toggle the occlusion setting to level 1.
4. Press [ON/OFF] to turn the infusion pump off. The occlusion setting is stored in memory.
5. Press [ON/OFF] to turn the infusion pump on.
6. Press PRIMARY [RATE] and set the rate to 100 ml/hr.
7. Press PRIMARY [VTBI] and set the VTBI to 100 ml.
8. Open the three-way stopcock to air.
9. Press [START] and allow the infusion pump to stabilize for a minimum of 15 seconds. Verify all air is cleared from the tubing.
10. Verify the reading on the DPM is approximately zero (0). Set the three-way stopcock to measure pressure.
11. Verify the occlusion alarm occurs when DPM indicates 6.0 ± 4.0 PSI.
12. Press [STOP].
13. Press [ON/OFF] to turn the infusion pump off.

14. Enter the Optional User Settings and Press PRIMARY [RATE] to toggle the occlusion setting to level 2.
15. Press [ON/OFF] twice.
16. Press PRIMARY [RATE] and set the rate to 100 ml/hr.
17. Press PRIMARY [VTBI] and set the VTBI to 100 ml.
18. Open the three-way stopcock to air.
19. Press [START] and allow the infusion pump to stabilize for a minimum of 15 seconds. Verify all air is cleared from the tubing.
20. Verify the reading on the DPM is approximately zero (0). Set the three-way stopcock to measure pressure.
21. Verify the occlusion alarm occurs when DPM indicates 10.0 ± 6.0 PSI.
22. Press [STOP].
23. Press [ON/OFF] to turn the infusion pump off.
24. Enter the Optional User Settings and press PRIMARY [RATE] to toggle the occlusion setting to level 3.
25. Press [ON/OFF] twice.
26. Press PRIMARY [RATE] and set the rate to 100 ml/hr.
27. Press PRIMARY [VTBI] and set the VTBI to 100 ml.
28. Open the three-way stopcock to air.
29. Press [START] and allow the infusion pump to stabilize for a minimum of 15 seconds. Verify all air is cleared from the tubing.
30. Verify the reading on the DPM is approximately zero (0). Set the three-way stopcock to measure pressure.
31. Verify the occlusion alarm occurs when DPM indicates 20.0 ± 8.0 PSI.
32. Press [STOP].
33. Press [ON/OFF] to turn the infusion pump off.

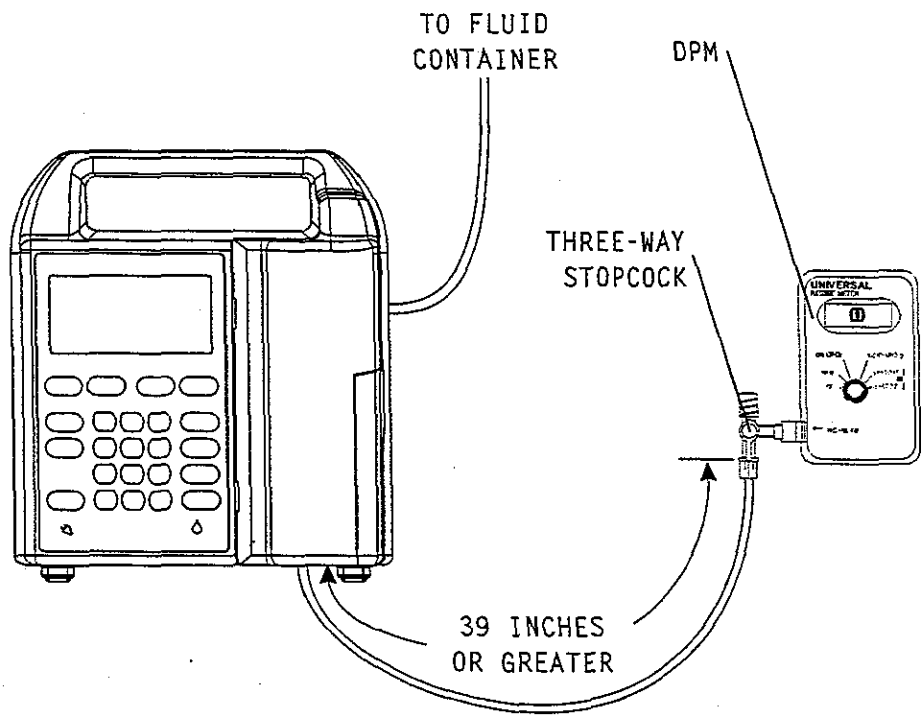

Figure 5-3. Occlusion Test Setup

5.2.12
DELIVERY ACCURACY TEST

Note: Accuracy testing is for informational purposes only, and is not to be used as a re-release test. If there is any concern as to infusion pump accuracy, contact Abbott Laboratories.

CAUTION: Do not remove the protective cover from the butterfly needle.

To perform the delivery accuracy test, proceed as follows:

1. Install a primed administration set and attach an 18-gauge cannula, or a 21-gauge needle to the distal end of the tubing. Verify the fluid container is 18 to 24 inches above the pumping chamber. Verify all lines are unclamped.
2. Prime the tubing. Verify no air is in the tubing. Place cannula or needle in a dry 25 ml graduated cylinder.
3. Press [ON/OFF] to turn the infusion pump on.
4. Press PRIMARY [RATE] and set the rate to 100 ml/hr.
5. Press PRIMARY [VTBI] and set the VTBI to 20 ml.
6. Press [START] to start pumping fluid.
7. Verify that after the VTBI is complete, the infusion pump changes to KVO mode at a rate of 1 ml/hr.
8. Press [STOP].
9. Verify volume delivered is 20 ± 2.0 ml.
10. Press [ON/OFF] to turn the infusion pump off.
11. Remove the administration set from the infusion pump.

5.2.13
ELECTRICAL SAFETY TEST

To perform the electrical safety test, proceed as follows:

1. Connect the infusion pump AC power cord to a safety analyzer.
2. Connect the safety analyzer ground lead to the infusion pump ground test-point located on the rear of the infusion pump.
3. Check the leakage current with the safety analyzer. Leakage current (both open and closed ground) must not exceed 100 microamperes (µA) (AC RMS).
4. Measure the resistance of the AC connector ground lug with the safety analyzer. Resistance should not exceed 0.1 Ω.

5.2.14
END OF PERFORMANCE VERIFICATION TEST

If all tests have been successful, proceed as follows:

1. Clear the dose history (press [CLR VOL] twice).
2. Reset the infusion pump to the original configuration.
3. Return the infusion pump to service.

Note: If any tests fail, refer to *Section 6, Troubleshooting*, or contact Abbott Laboratories.

5.3
PERIODIC MAINTENANCE INSPECTION

Periodic maintenance inspections should be performed per hospital procedures for compliance to accreditation requirements. It is recommended that JCAHO and/or hospital protocol be followed for establishing an infusion pump periodic maintenance inspection schedule. Product specifications for this inspection are listed in *Section 8, Specifications.* To perform the periodic maintenance inspection, complete the performance verification test *(see Section 5.2, Maintenance and Service Tests).*

5.4
BATTERY OPERATION OVERVIEW

The infusion pump is intended to operate on battery power on an exception basis only, such as emergency backup or temporary portable operation. Examples of emergency backup include AC power failure or inadvertent disconnection of the AC power cord. An instance of temporary portable operation includes patient transfer from one location to another.

The infusion pump should be connected to AC power whenever possible to allow the battery to remain fully charged. The infusion pump line power indicator turns off and the BATTERY legend illuminates when the infusion pump is operating on battery power. The backlight extinguishes after one minute of pump operation on battery power.

Factors that most commonly affect battery life are the depth and frequency of discharge and the length of the recharge period. As a general rule, the more often the battery is discharged and recharged, the sooner it will need replacement. The primary cause of damage is leaving the battery in a less than fully charged state for any period of time. Battery damage can occur in a matter of hours and cause a permanent loss of battery capacity. The amount of lost capacity depends on the degree of discharge, the storage temperature, and the length of time the battery was stored in a discharged state.

Note: A permanently damaged battery cannot be recharged to full capacity.

When the battery discharges below the acceptable level while the infusion pump is operating, the alarm sounds and the flashing BATTERY message displays. Although it is not recommended to continue operating the infusion pump on battery power at this point, the battery continues providing power until discharged. At this point, the infusion pump enters the battery discharged mode, a continuous audible alarm sounds and after three minutes, operation ceases.

CAUTION: As soon as the flashing BATTERY alarm occurs, connect the infusion pump to AC power.

Recharging occurs any time the infusion pump is connected to AC power. It is recommended that the infusion pump be connected to AC power whenever practical to maximize available battery charge during transport or ambulation. The infusion pump does not have to be on for the battery to recharge. Recharging while the infusion pump is operating is rate dependent.

Note: The infusion pump should be operated on battery power for six continuous hours at least once every six months for optimum battery performance and life.

5.4.1
BATTERY CHARGER CURRENT TEST (OPTIONAL)

To perform the battery charger current test, proceed as follows:

Note: Make certain the battery is in good condition and charged. If necessary, use a second battery for this test.

1. Disconnect the infusion pump from AC power. Remove the battery access cover and disconnect the battery.
2. Connect the battery charger test circuit. Make certain switch S1 is in the off position.
3. Connect the infusion pump to AC power and read the current on the current meter. Allow 20 seconds for the current to stabilize.
4. Compare the measured current to the minimum and maximum readings listed in *Table 5-2, Battery Charger Current Test Parameters.*

   Note: If the reading is too low, the battery may be fully charged. Close switch S1; repeat Step 3 and verify per *Table 5-2.*

5. Disconnect the infusion pump from AC power. Remove the battery charger test circuit. Reconnect the battery to the infusion pump. Replace the battery access cover and secure it.

Table 5-2. Battery Charger Current Test Parameters

Minimum Reading	Maximum Reading
0.85 amps	1.15 amps

Section 6

TROUBLESHOOTING

This section contains information on obtaining technical assistance, and alarm messages and error codes for the Acclaim Encore Infusion Pump.

6.1 TECHNICAL ASSISTANCE

For technical assistance, product return authorization, and to order parts, accessories, or manuals within the United States, contact Abbott Laboratories Technical Support Operations.

1-800-241-4002

To order parts using the online eCatalog, download technical publications, technical training courses, and additional services, visit the website at:

www.abbotthpd.com

Send all authorized, prepaid returns within the United States to the following address:

Abbott Laboratories
Technical Support Operations
755 Jarvis Drive
Morgan Hill, California 95037

For technical assistance, product return authorization, and to order parts, accessories, or manuals from outside the United States, contact the nearest Abbott Laboratories sales office.

6.2 ALARM MESSAGES AND ERROR CODES

Under most alarm conditions, the infusion pump ceases normal operation, generates an audible alarm, and displays an alarm message or error code on the LCD screen. There are two categories of alarm message codes: alarm codes that can be cleared by the operator, and error codes that require qualified service personnel.

6.2.1
OPERATIONAL ALARM MESSAGES

Table 6-1, Operational Alarm Messages and Corrective Actions, lists infusion pump alarm codes that can be cleared by the operator. Also listed in *Table 6-1* are the alarm messages, descriptions, possible causes, and corrective actions.

Note: Operational alarm messages are displayed on the LCD screen. Associated error codes are displayed in the alarm history.

Table 6-1. Operational Alarm Messages and Corrective Actions

Alarm Code	Alarm Message	Description	Possible Cause	Corrective Action	If Problem Persists
50	BATTERY	VBAT signal is less than 7.1 volts for five seconds. Device alarms and displays only "L"	Discharged battery	Recharge battery	Replace battery *(see Section 7.2.4)*
51	BATTERY	VBAT signal is less than 7.6 volts for five seconds	Low battery	Connect the infusion pump to AC power	Replace battery *(see Section 7.2.4)*
52	AIR IN LINE	200 µl of air is detected in any 2 ml of fluid delivered (10%) and L1 sensitivity is selected or 500 µl of air is detected in any 2 ml of fluid delivered (25%) and L2 sensitivity is selected	Total Air-In-Line	Reprime set	Clean air sensor Replace mechanism *(see Section 7.2.7.3)*
53	AIR IN LINE	100 µl of continuous air is detected with L1 sensitivity, 200 µl of continuous air with L2 sensitivity, or 1.5 ml of continuous air with sensitivity OFF	Bolus Air-In-Line	Reprime set	Clean air sensor Replace mechanism *(see Section 7.2.7.3)*
54	OCCLUSION	Distal pressure is too high	Distal occlusion	Clear occlusion	Clean tubing path Replace mechanism *(see Section 7.2.7.3)*

Table 6-1. Operational Alarm Messages and Corrective Actions

Alarm Code	Alarm Message	Description	Possible Cause	Corrective Action	If Problem Persists
55	OCCLUSION	Proximal pressure is too low	Proximal occlusion	Clear occlusion	Clean tubing path Replace mechanism *(see Section 7.2.7.3)*
56	CHECK DOOR	Door is detected in open position and active fluid delivery is taking place	Check door	Close door handle completely	Confirm door is fully closed Confirm door handle is not loose Check door magnet Replace mechanism *(see Section 7.2.7.3)* Replace mechanism cable *(see Section 7.2.7.3)*
57	STOPPED	Delivery has been set up and not started for more than five minutes. Alert is 5 beeps every minute, prior to this alarm	Idle	Turn off, setup, or start device	N/A
58	CHECK SETTINGS	Insufficient or incorrect parameter entry before pumping	Check settings	Correct entry	N/A
59	CLAMP SYMBOL DISPLAYED	Door is detected in the closed position and clamp sensor is inactive	Clamp not present	Insert slide clamp	Confirm slide clamp is fully inserted and moves freely Replace mechanism *(see Section 7.2.7.3)*
60	VTBI COMPLETE	VTBI has reached 0	VTBI complete	Reprogram or turn off	N/A
61	LOCKED	STOP key was pressed while the keypad was locked	Keypad locked	Unlock keypad	Replace volume control and lockout PWA *(see Section 7.2.8.4)*

Table 6-1. Operational Alarm Messages and Corrective Actions

Alarm Code	Alarm Message	Description	Possible Cause	Corrective Action	If Problem Persists
62	CHECK and CLAMP symbol flash	Slide clamp has not closed when door opens	Slide clamp mechanism Soiled slide clamp mechanism	Close and reopen door Clean slide clamp mechanism of any residue	Confirm slide clamp is fully inserted and moves freely Replace mechanism *(see Section 7.2.7.3)*
63	OCCLUSION	Distal pressure too low	Tubing out of sensor	Remove and reload tubing	Replace mechanism *(see Section 7.2.7.3)* Replace mechanism cable *(see Section 7.2.7.3)*
64	OCCLUSION	Proximal pressure too low	Tubing out of sensor	Remove and reload tubing	Replace mechanism *(see Section 7.2.7.3)* Replace mechanism cable *(see Section 7.2.7.3)*
65	BATTERY OFF	Battery is overcharged Battery unable to charge properly	Battery fault	Cycle the power	Replace battery *(see Section 7.2.4)*

6.2.2
ERROR CODES REQUIRING TECHNICAL SERVICE

Table 6-2, Error Codes Requiring Technical Service, lists infusion pump error codes that require technical service. Also listed in *Table 6-2* are the malfunction descriptions, possible causes, and corrective actions.

Note: The error code is displayed on the LCD screen; associated malfunction descriptions are not displayed. If reference to alarm history is required, refer to *Section 1.8, General Service Mode*.

Table 6-2. Error Codes Requiring Technical Service

Code Displayed	Malfunction Description	Possible Cause	Corrective Action
100	Stack overflow	MCU RAM error	Replace MCU PWA *(see Section 7.2.9.1)*
101	Critical data checksum failure	Corrupt data in EEPROM Open wire in mechanism cable Critical data checksum ongoing	Replace mechanism *(see Section 7.2.7.3)* Replace mechanism cable *(see Section 7.2.7.3)* Replace MCU PWA *(see Section 7.2.9.1)*
102	ROM checksum failure	ROM checksum at turn-on	Replace MCU PWA *(see Section 7.2.9.1)*
103	Calibration data checksum failure	Corrupt data in EEPROM Open wire in mechanism cable	Replace mechanism *(see Section 7.2.7.3)* Replace mechanism cable *(see Section 7.2.7.3)*
104	EEPROM Failure	Corrupt data in EEPROM Open wire in mechanism cable	Replace mechanism *(see Section 7.2.7.3)* Replace mechanism cable *(see Section 7.2.7.3)*
105	Audio transducer failure	CPU did not detect audio circuit Faulty audio circuit	Replace piezo transducer *(see Section 7.2.8.6)* Replace volume control and lockout PWA *(see Section 7.2.8.4)* Replace volume control and lockout PWA cable *(see Section 7.2.8.4)*
106	Key switch stuck active	Key switch stuck	Replace keypad *(see Section 7.2.7.2)*
107	Time base malfunction	Faulty CPU clock	Replace display PWA *(see Section 7.2.7.1)* Replace display PWA cable *(see Section 7.2.7.1)* Replace MCU PWA *(see Section 7.2.9.1)*

Table 6-2. Error Codes Requiring Technical Service

Code Displayed	Malfunction Description	Possible Cause	Corrective Action
108	Motor phase loss	Motor will not home, flag always seen, motor encoder faulty Motor will not home, flag never seen, motor encoder faulty Motor phase loss, motor turning too slowly	Replace mechanism *(see Section 7.2.7.3)*
109	Hardware timers failure	Hardware timers failure Internal timer comparison failed	Replace MCU PWA *(see Section 7.2.9.1)*
110	MCU ADC test failure	A/D converter test failure, faulty reference channel (5 Volt or 0.5 Volt reference)	Replace MCU PWA *(see Section 7.2.9.1)*
111	Sensor ADC test failure	Sensor A/D failure, faulty reference channel (5 Volt or 0.5 Volt)	Replace mechanism *(see Section 7.2.7.3)* Replace mechanism cable *(see Section 7.2.7.3)*
112	Air sensor off failure	Air sensor signal seen with sensors disabled	Replace mechanism *(see Section 7.2.7.3)* Replace mechanism cable *(see Section 7.2.7.3)*
113	Air sensor on failure	Air sensor value > 2.5V	Replace mechanism *(see Section 7.2.7.3)* Replace mechanism cable *(see Section 7.2.7.3)*
114	Power supply malfunction	Power supply malfunction HKDC too high	Replace power supply PWA *(see Section 7.2.8.2)*
115	VMOT voltage malfunction	Power supply malfunction VMOT out of range	Replace power supply PWA *(see Section 7.2.8.2)*

Table 6-2. Error Codes Requiring Technical Service			
Code Displayed	**Malfunction Description**	**Possible Cause**	**Corrective Action**
118	Anti free-flow detection sensor malfunction	Sensor signal faulty	Check slide clamp operation Replace mechanism *(see Section 7.2.7.3)* Replace mechanism cable *(see Section 7.2.7.3)*
119	Tubing temperature sensor malfunction	Tubing temperature sensor out of range	Replace mechanism *(see Section 7.2.7.3)* Replace mechanism cable *(see Section 7.2.7.3)*
120	Ambient temperature sensor malfunction	Ambient temperature sensor out of range	Replace mechanism *(see Section 7.2.7.3)* Replace mechanism cable *(see Section 7.2.7.3)*
200 and up	Software errors	Corrupted software	Replace MCU PWA *(see Section 7.2.9.1)*

6.3 TROUBLESHOOTING PROCEDURES

This section details recommended troubleshooting procedures for problems not associated with malfunction alarms. Before performing any troubleshooting procedure, turn the Acclaim Encore Infusion Pump power off, then on. Allow the self test to complete and proceed as follows:

1. If a malfunction exists, carefully inspect the Acclaim Encore Infusion Pump for damage as described in *Section 5.2.2, Inspecting the Infusion Pump.*
2. If an inspection has not disclosed a malfunction, perform the PVT *(see Section 5.2, Performance Verification Test)* and refer to *Table 6-3, Troubleshooting with the PVT,* for PVT section reference, probable causes, and corrective actions.
3. If after completing Steps 1 and 2, a malfunction has not been located, or if the infusion pump persistently fails, contact Abbott Laboratories Technical Support Operations.

Table 6-3. Troubleshooting with the PVT

PVT Test Failure	Probable Cause	Corrective Action
Fails Self Test *(Section 5.2.4)*	Damaged main PWA	Replace MCU PWA *(see Section 7.2.9.1)*
	Damaged display PWA	Replace display PWA and/or display ribbon cable *(see Section 7.2.7.1)*
	Damaged power supply PWA	Replace power supply PWA *(see Section 7.2.8.2)*
	Damaged mechanism	Replace mechanism *(see Section 7.2.7.3)*
Fails AC Signal *(Section 5.2.4)*	Blown Fuse	Replace fuse *(see Section 7.2.8.1)*
	Damaged AC power cord or plug	Replace AC power cord *(see Section 7.2.8.3)*
	Damaged power supply PWA	Replace power supply *(see Section 7.2.8.2)*
Fails Free Flow Test *(Section 5.2.5)*	Damaged mechanism	Replace mechanism *(see Section 7.2.7.3)*
Fails Keypad Test *(Section 5.2.6)*	Damaged keypad and/or display ribbon cable	Replace display PWA and or display ribbon cable *(see Section 7.2.7.1)*
Fails Door Open/Alarm Loudness Test *(Section 5.2.7)*	Damaged alarm circuit or cable	Replace volume control and lockout PWA *(see Section 7.2.8.4)*
	Damaged piezo transducer	Replace piezo alarm transducer *(see Section 7.2.8.6)*
Fails Lockout Switch Test *(Section 5.2.8)*	Damaged lockout switch or switch cable	Replace volume control and lockout PWA *(see Section 7.2.8.4)*
Fails Proximal Occlusion Test *(Section 5.2.9)*	Damaged mechanism	Replace mechanism *(see Section 7.2.7.3)*
Fails Air-In-Line Alarm Test *(Section 5.2.10)*	Damaged mechanism	Replace mechanism *(see Section 7.2.7.3)*
Fails Distal Occlusion Test *(Section 5.2.11)*	Damaged mechanism	Replace mechanism *(see Section 7.2.7.3)*
Fails Delivery Accuracy Test *(Section 5.2.12)*	Damaged mechanism	Replace mechanism *(see Section 7.2.7.3)*
Fails Electrical Safety Test *(Section 5.2.13)*	Damaged AC plug or AC power cord	Replace AC power cord *(see Section 7.2.8.3)*
	Damaged power supply PWA	Replace power supply PWA *(see Section 7.2.8.2)*

Section 7

REPLACEABLE PARTS AND REPAIRS

This section itemizes all parts and subassemblies of the Acclaim Encore Infusion Pump that are repairable within the scope of this manual. In addition, this section details replacement procedures for all listed parts.

7.1 REPLACEABLE PARTS

Replaceable parts for the Acclaim Encore Infusion Pump are itemized in the spare parts price list and are identified in *Figure 9-1, Illustrated Parts Breakdown. Table 9-2, IPB for the Infusion Pump* identifies each part by an index number that correlates to *Figure 9-1.* To request a copy of the current spare parts price list, contact Abbott Laboratories *(see Section 6.1, Technical Assistance)* or to view the catalog online, visit the website at:

www.abbotthpd.com/parts

For convenient reference, insert a copy of the spare parts price list here.

7.2 REPLACEMENT PROCEDURES

This section contains safety and equipment precautions, required tools and materials, and step-by-step procedures for replacing parts in the infusion pump. Unless otherwise stated, always perform the PVT after a replacement procedure.

7.2.1 SAFETY AND EQUIPMENT PRECAUTIONS

Before opening the front enclosure of the infusion pump, take all necessary precautions for working on high-voltage equipment.

WARNING

UNLESS OTHERWISE INDICATED, DISCONNECT THE INFUSION PUMP FROM AC POWER BEFORE PERFORMING ANY REPLACEMENT PROCEDURE.

WARNING

POSSIBLE EXPLOSION HAZARD IF INFUSION PUMP IS SERVICED OR REPAIRED IN THE PRESENCE OF FLAMMABLE ANESTHETICS.

CAUTION: Use proper ESD grounding techniques when handling components. Wear an antistatic wrist strap and use an ESD-protected workstation. Store the PWAs in antistatic bags before placing them on any surface.

7.2.2 REQUIRED TOOLS AND MATERIALS

The following tools and materials, or equivalents, are required for the replacement procedures in this section. In addition, the beginning of each procedure lists tools and materials required for that specific procedure.

- ❑ Set of nutdrivers
- ❑ Small size flat blade screwdriver
- ❑ Medium size flat blade screwdriver
- ❑ No. 2 Phillips screwdriver
- ❑ Set of Allen wrenches
- ❑ Fuse puller
- ❑ Wide head pliers
- ❑ Long needle nose pliers
- ❑ Diagonal cutters
- ❑ X-acto® knife (with square, round, and pointed blades)
- ❑ Wood chisel, 3/8 inch
- ❑ Strain relief bushing extractor
- ❑ Mild solvent (such as isopropyl alcohol)